Remediation Technologies to Protect the Columbia River at Hanford, WA

6th Washington Hydrogeology Symposium

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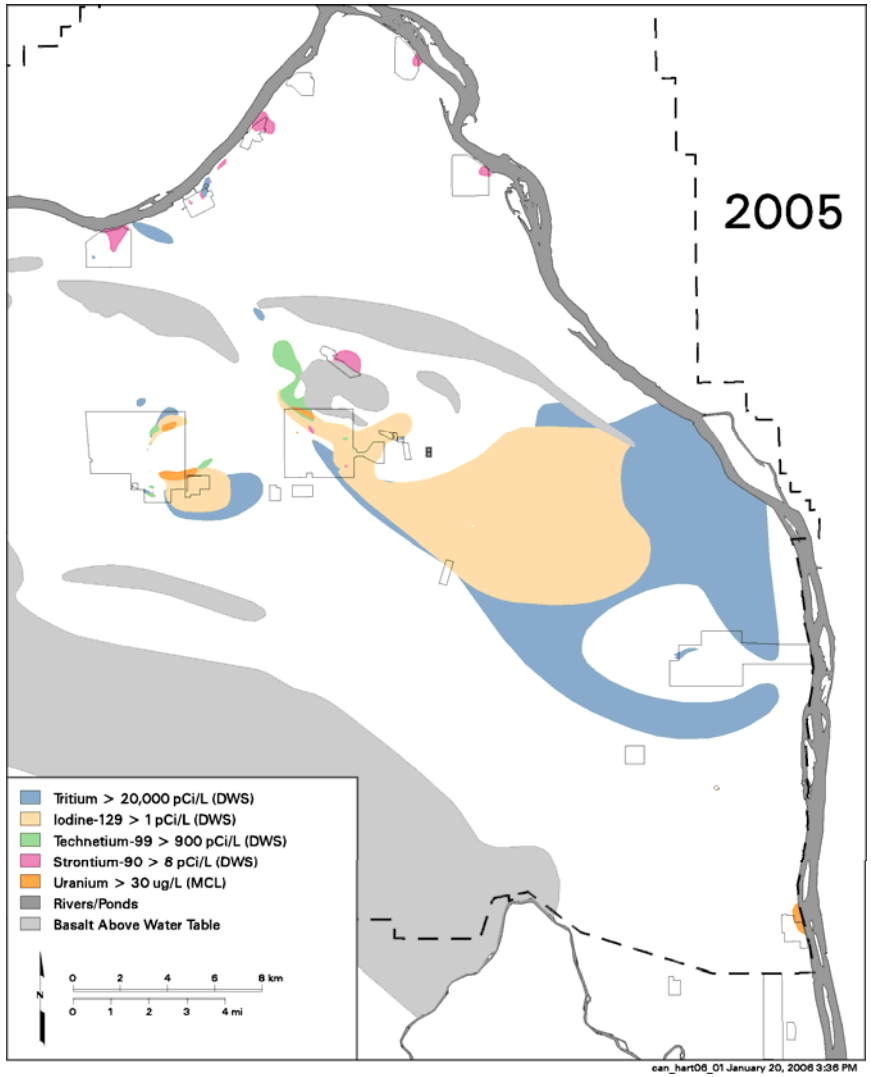
Stakeholder Values Articulated by the Hanford Advisory Board

- Protect the Columbia River
- Deal realistically and forcefully with groundwater contamination
- Get on with cleanup
- Do no harm during cleanup
- Use the most practicable, timely, available technology, while leaving room for future innovation

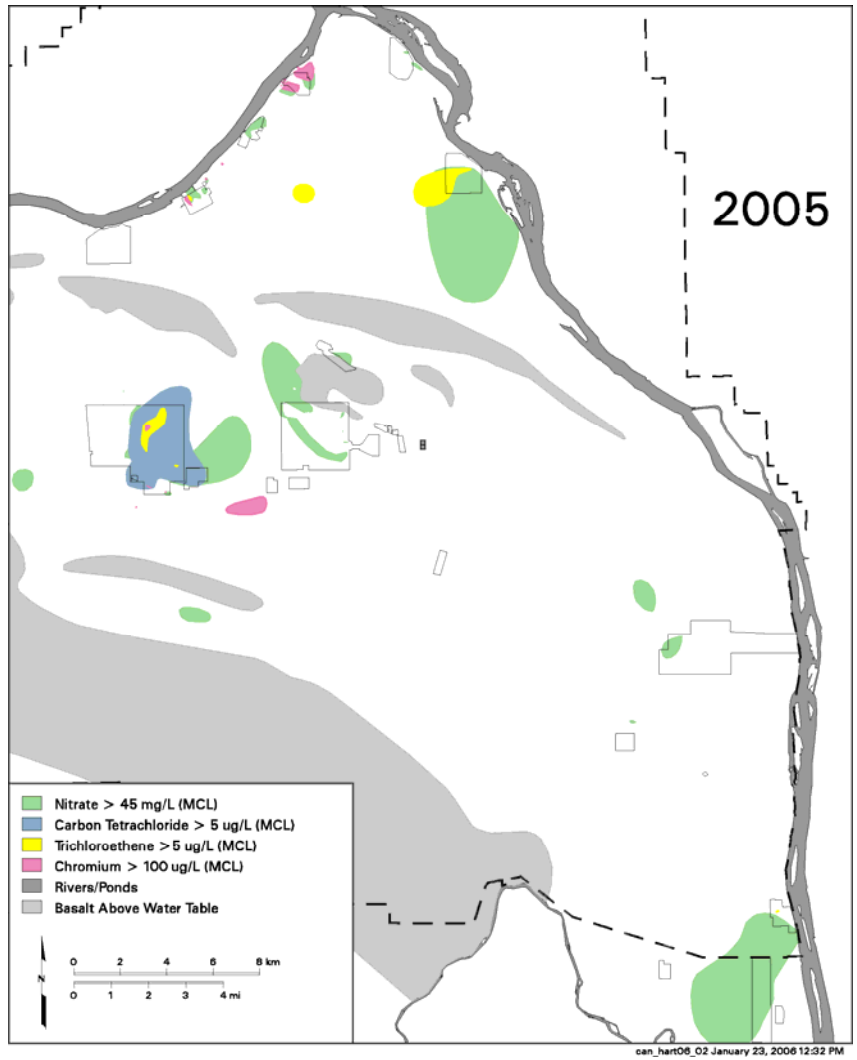
Radioactive Contaminants

- Tritium
- Iodine-129
- Technetium-99
- Uranium
- Strontium-90

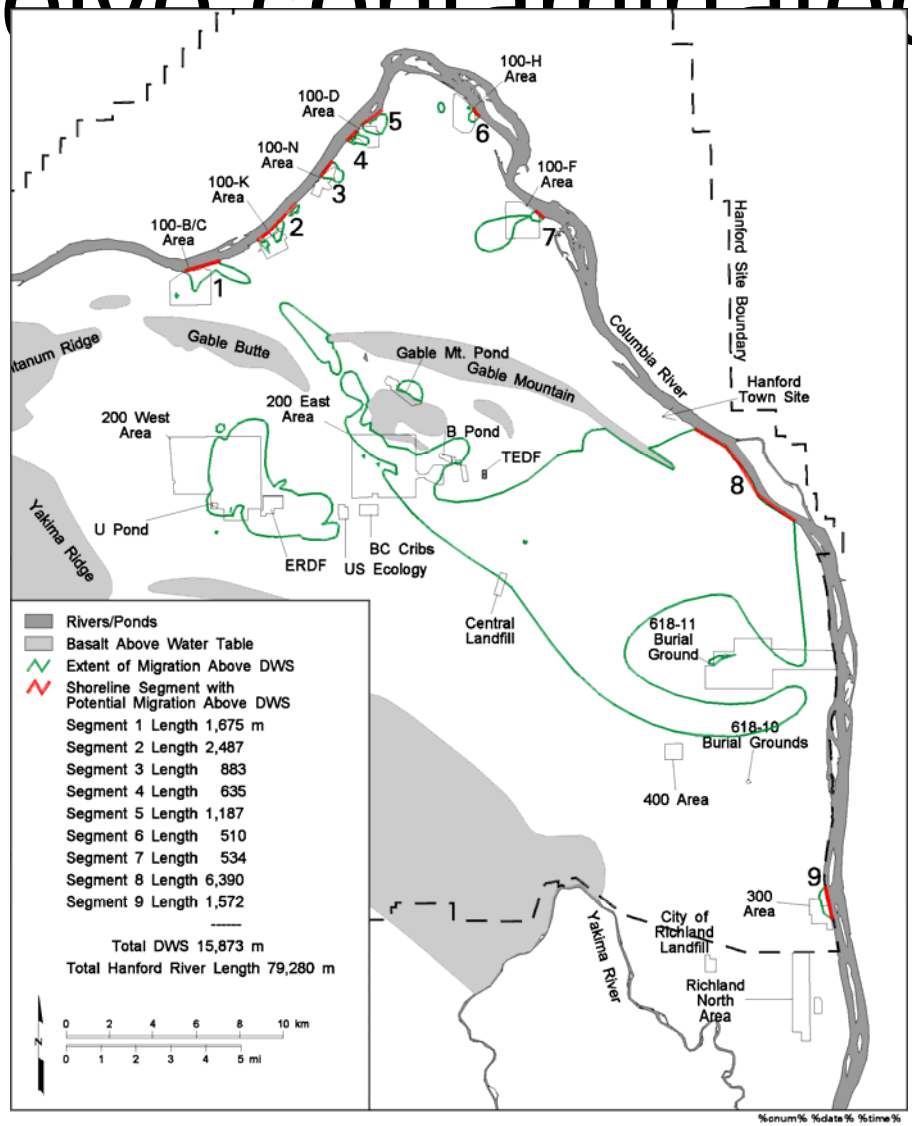


Chemical Contaminants

- Nitrate
- Carbon tetrachloride
- Trichloroethene
- Hexavalent chromium

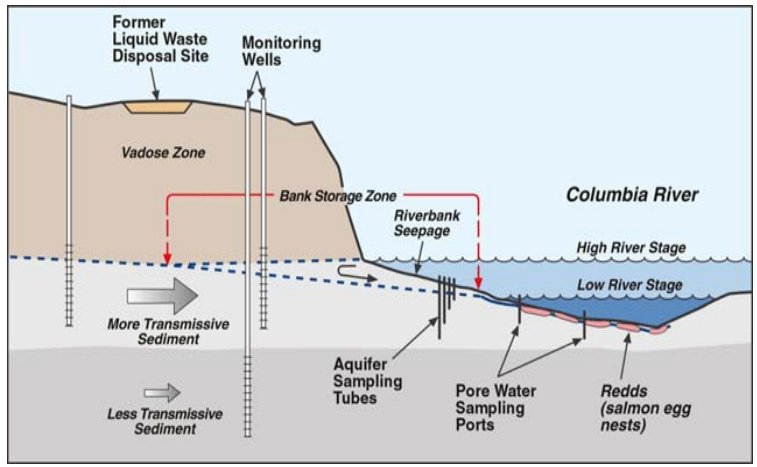


Approximately 20,000 meters of Columbia River shoreline receive contaminated



Current Exposure at the Columbia River From Hanford-Derived Contaminants to Humans and Other Biota is localized

- Hyporheic Zone - contaminated groundwater upwells into the gravel bed of the river
- Riparian Zone - seeps containing a mixture of river water and groundwater



2006 GAO Audit & Congressional Response

The conferees are concerned about DOE's efforts to protect contaminants from reaching the Columbia River. Technology used in several remedies is not performing satisfactorily, and there is a lack of new technologies to address contamination issues.

Key Hanford Contaminants Relevant to Congressional Concerns in CY 2006

- Contaminants Currently Entering the River
  - Hexavalent Chromium in the 100 Area reactor sites & the "Horn" of the river
  - Strontium-90 at 100-N
  - Uranium at the 300 Area
  - Tritium from 200 East Area (PUREX)
  - Iodine-129 from 200 East Area (PUREX)
- Contaminants that may reach the River in the future from the 200 Area (Based on mobility, half-life & inventory)
  - Technitium-99
  - Uranium
  - Carbon Tetrachloride

Proposal Preparation Criteria

- Projects that could be deployed to meet the objectives of the congressional appropriation.
- Projects that addressed the groundwater cleanup deficiencies identified by the U.S. General Accountability Office (GAO) audit.
- Technologies that had some history of development and posed a reasonable chance of near-term successful deployment.

Steering Committee Selection Criteria

- **Relevance**: Contaminants currently entering the Columbia River or likely to enter the Columbia River due to proximity, mobility, quantity and persistence
- **Risk Reduction**: Particularly health and ecological risks to the Columbia River and associated receptors
- **Baseline Improvement**: Deficiencies in meeting remedial action goals
- **Implementable**: Deployable within 12 to 18 months, measurable documentation of performance, and minimal risk of adverse collateral impacts
- **Acceptable**: Supported by regulators, tribal and local governments and stakeholders

Independent Technical Peer Review Panel Criteria

- Eight to ten experts reviewed each of the proposals
- The reviewers identified and evaluated each proposed technology in the context of the target contaminant plume for:
  - Issues and uncertainties/probability of success
  - Technical basis
  - Implementation strategy
  - Performance metrics
  - Underpinning science
  - Cost and level of effort
  - Potential alternatives

FY 2008 Columbia River Protection Projects Funded by $10M Directed Funding

Hexavalent Chromium in the 100-D & 100-K Areas

- Inject Micron-size Iron into Deteriorating Portions of the In Situ Redox Manipulation (ISRM) Barrier
- Field Test Electrocoagulation for Accelerated Cleanup of the Northeastern Plume in the 100-D Area
- Accelerated Bioremediation (Biostimulation)
- Geochemical/Mineralogical Study of Chromium in the Vadose Zone
- Refine Location of the Chromium Source at the 100-D Area

Strontium-90 in the 100-N Area

- Sequestration of Sr-90 Subsurface Contamination in the Hanford 100-N Area by Surface Infiltration of an Apatite Solution
- 100-N Area Strontium-90 Treatability Demonstration Project: Phytoremediation along the 100-N Columbia River Riparian Zone

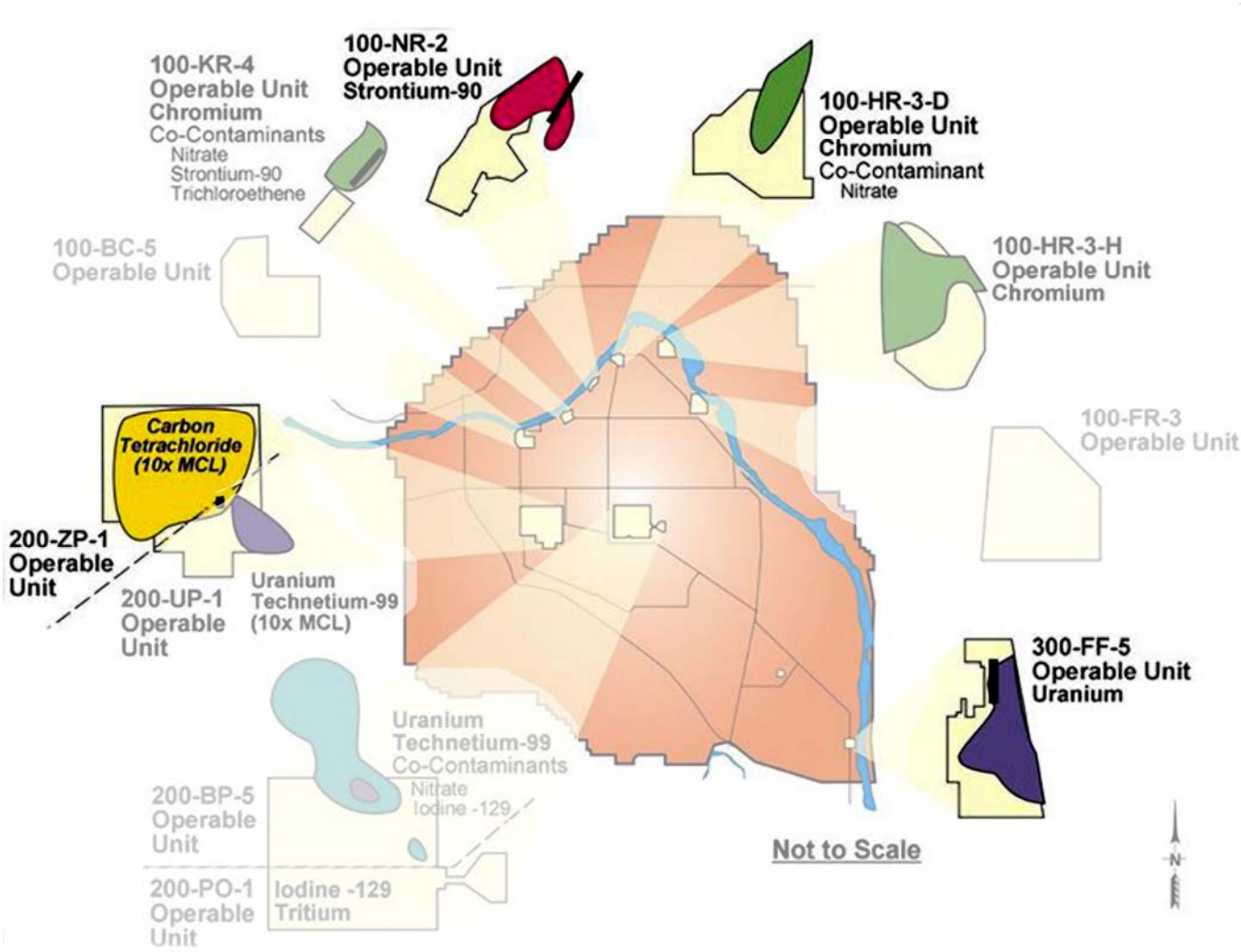
Uranium in the 300 Area

- 300 Area Uranium Plume Treatability Demonstration Project: Uranium Stabilization through Polyphosphate Injection

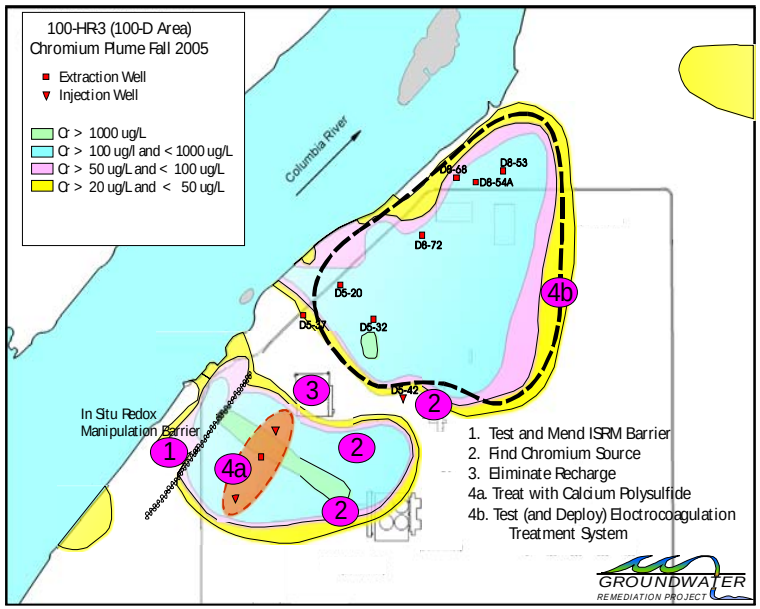
Carbon Tetrachloride in the 200 Area

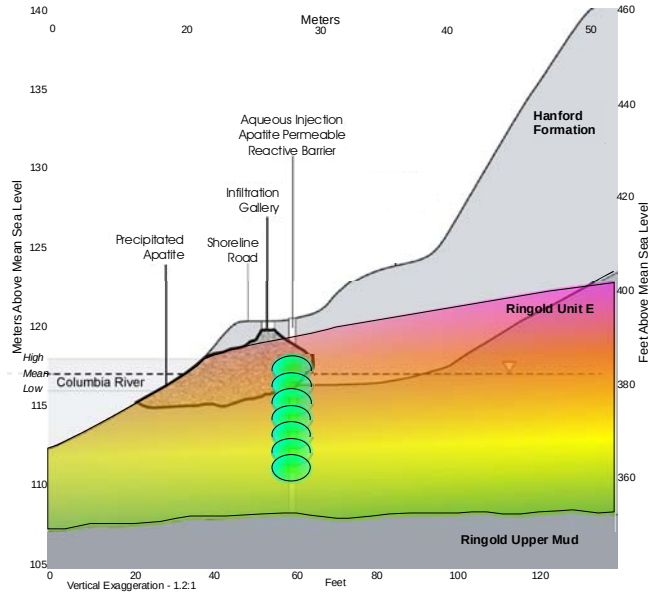
- Carbon Tetrachloride and Chloroform Attenuation Parameter Studies: Heterogeneous Hydrolytic Reactions

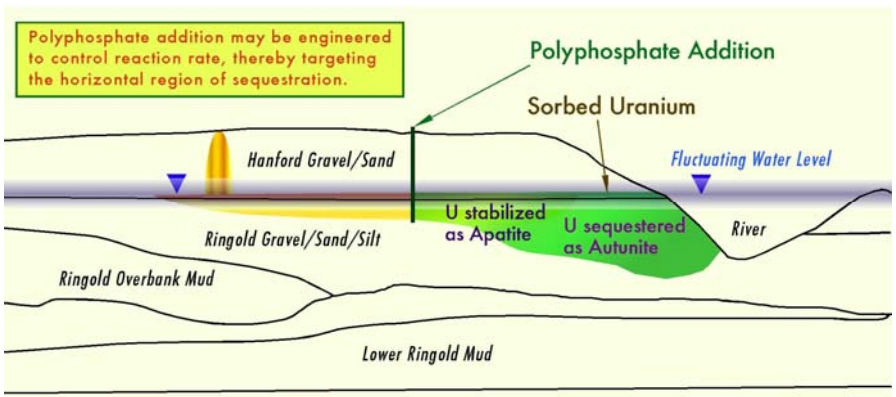
CERCLA Operable Units Impacted by the Nine Projects

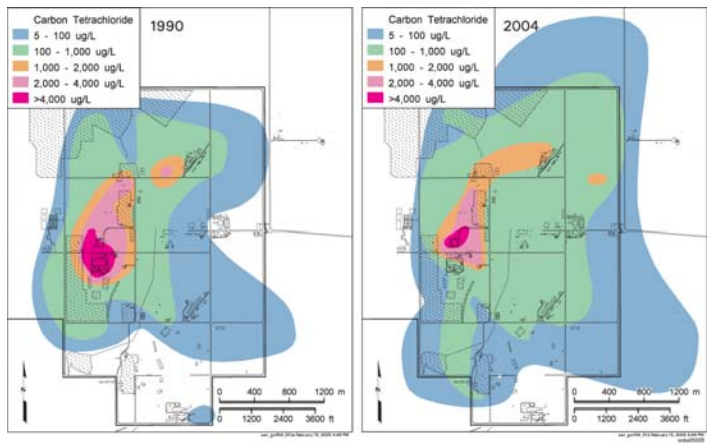


Four Areas of Focus – FY 2006









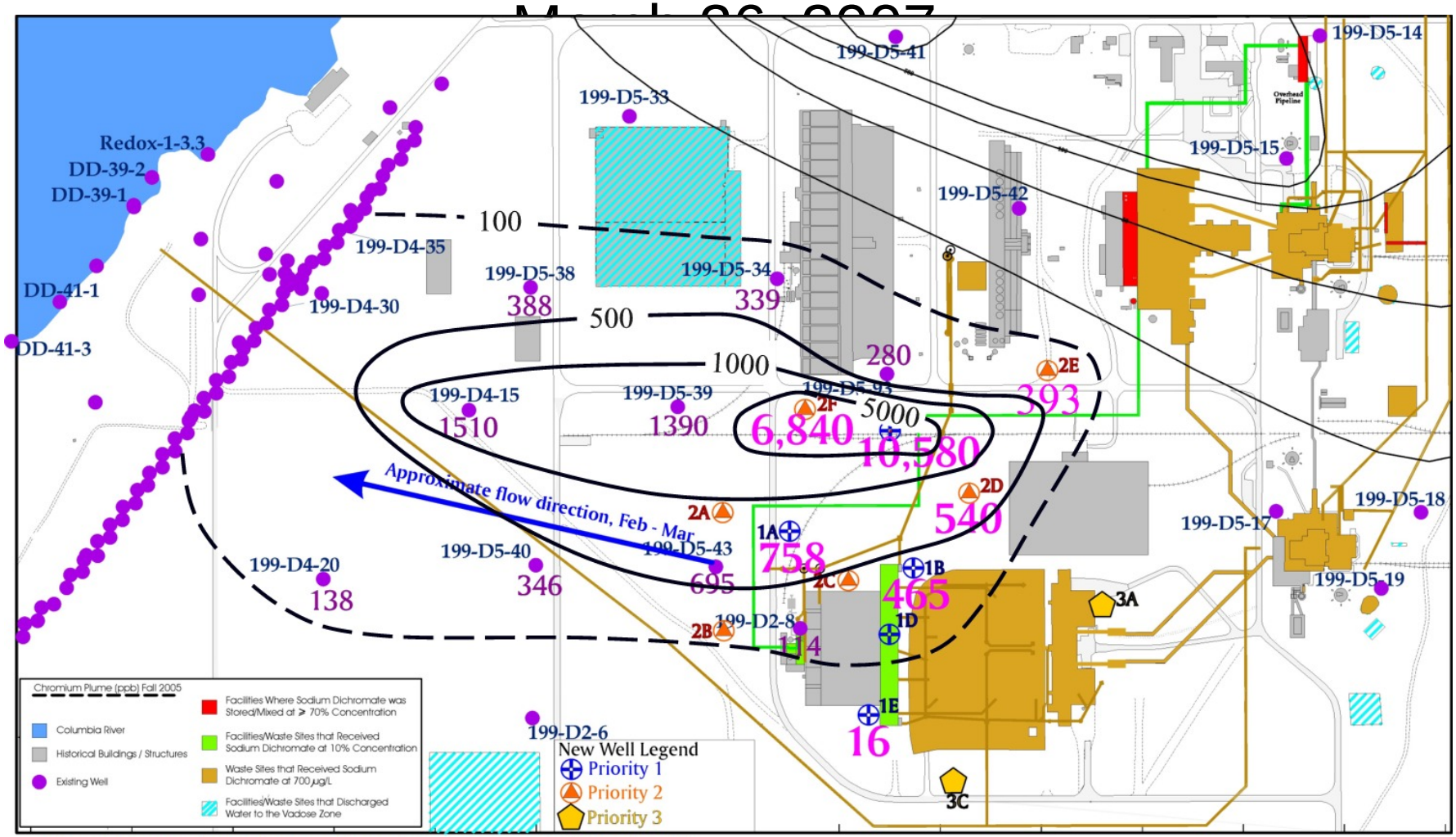
Progress - Hexavalent Chromium in the 100-D & 100-K Areas

- Inject Micron-size Fe into ISRM Barrier
  - Lab tests & modeling underway at MSE
  - Field Demo scheduled for July 2007
- Field Test EC
  - Wells drilled and piping installed
  - 50 GPM system components delivered to Site
  - May 1, 2007 scheduled start-up
- Accelerated Bioremediation
  - Wells sited; drilling scheduled for May 2007

- Geochemical/Mineralogical Study of Cr in the VZ
  - Samples collected
  - Leaching studies underway, preliminary data on Cr aging effects

- Refine Location of the Chromium Source at the 100-D Area
  - Drilling of 7 wells complete
  - Data indicates we are close to a significant VZ source of Cr

100-D Chromium Source Investigation Results



Hexavalent chromium values in parts per billion (ug/L)

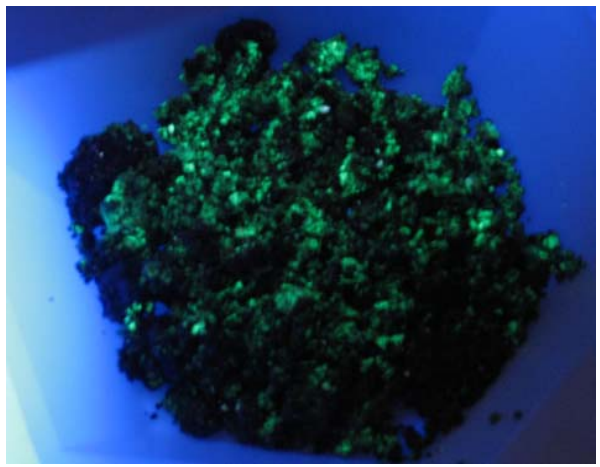
Progress - Strontium-90 in the 100-N Area

- Site-Funded initial 300 ft barrier completed in Ringold Fm. during recent low river stage
  - 2nd injection campaign to inject into Hanford Fm during high river stage scheduled for June 2007
  - CY 2008 higher-concentration injection campaign(s) to add robustness to the barrier
- Lab tests underway to support VZ application of apatite barrier – favorable initial results
- Field tests at “cold” 100-K location underway to determine biomass potential of coyote willows – phytoremediation as a polishing step to the apatite barrier

Sr-90 Activities 100-N

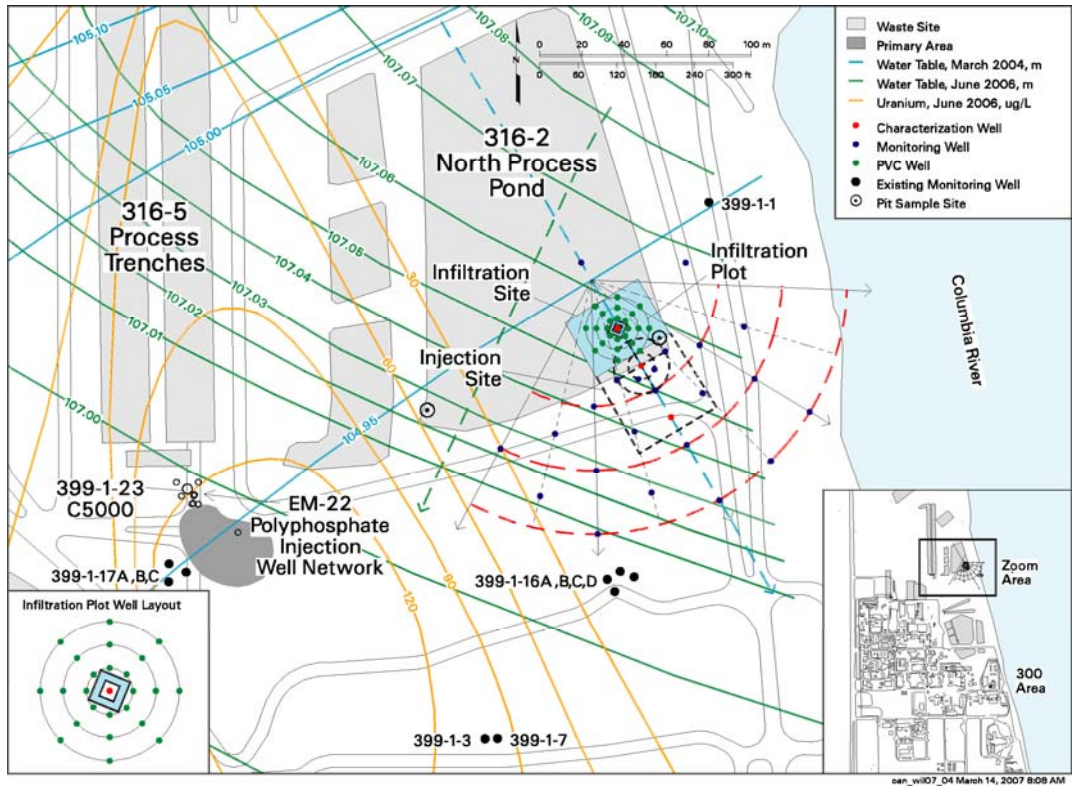
Progress - Uranium in the 300 Area

- Lab tests near completion – favorable results
- Initial field tracer test completed
- Field phosphate injection test scheduled for June 2007



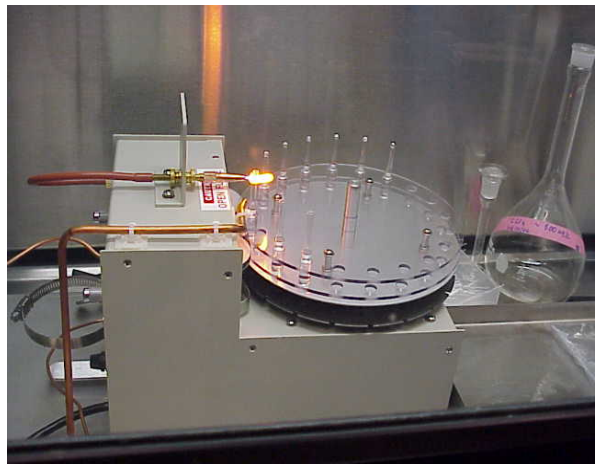
Other 300 Area GW Progress

- Limited Field Investigation
  - LFI Report
  - Preliminary remedial technology evaluation
  - 618-2 BG Pu transport resolved
  - TCE characterization wells planned
- 300 Area Risk Assessment Update
  - Draft released
- 300 Area Multi-Year Field Investigation funded by Office of Science – U Geochemistry



Progress - Carbon Tetrachloride in the 200

- Lab test initiated
- Collaboration with Dr. Peter Jeffers (SUNY Cortland)
- Multi-Year experiment



Proposed Path Forward

- Develop a “portfolio” of S&T needs, pursuing multiple funding sources for projects
  - RL-30 FY 2007/2008 baseline funding;
  - FY 2007 EM-20 funding for a continuation of selected FY 2006 projects;
  - EM-20 competitive procurement (FY 2007 & FY 2008); and,
  - EM-20 S&T Roadmap.